Interactive comment on "The role of termite CH4 emissions on ecosystem scale: a case study in the Amazon rain forest" by Hella van Asperen et al.
Anonymous Referee #3

This study presented a global interesting issue of termite CH_4/CO_2 emission in an Amazonian tropical rainforest. As a case study, this *in-situ* measurement of termite mound emissions provided information about termite CH_4/CO_2 production under natural conditions, it will contribution some knowledge to Biogeosciences. However, the field experiment was not well designed, and the limited data was not well analyzed. I would like to encourage the authors to revise the manuscript following my comments.

General comments:

1. "The blank measurements (collar with only soil and litter) showed an average CH_4 emission of 1.15 nmol collar^{-1} s^{-1}" (L175) means the forest soil was a VERY LARGE CH_4 SOURCE (4.6 nmol m^{-2} s^{-1} or 23.2 kg CH_4 ha^{-1} y^{-1}). It was a FUNDAMENTAL PROBLEM! Actually, the "blank" soil should be CH_4 sink. Even "1.15 nmol collar^{-1} s^{-1}" was "-1.15 nmol collar^{-1} s^{-1}", the soil CH_4 sink of "-23.2 kg CH_4 ha^{-1} y^{-1}" was an unbelievable large value.
2. An early study in a Southeast Asian tropical forest showed that the populations of termites was 3,000 – 4,000 m^{-2}, 60% of which being wood-feeding termites and 30% being either litter-feeding or humus-feeding species (Chiba, 1978). This population density was supported by many recent studies showed in this manuscript (L356-358). Why this study did not include the major termite species (wood-feeding)?
3. Large variations in both CH_4 and CO_2 emissions (figure 1; L221-222, L240) among the mounds suggest that the five applicates (mounds) was not enough to represent the ecosystem level CH_4 and CO_2 emissions. From your statement (2.6: sub sample), I would guess that your CH_4/CO_2 flux measurements were conducted for all the 19 mounds but not only 5 mounds (figure 1). If my guess is correct, the authors should explain (in the Method) the reasons for not including the data from other mounds, for example, the other mounds were not active mounds. Moreover, the authors should explain why the sub sample experiment was only conducted for one mound (L161: "only one sub sample was found suitable from the all 19 mounds").
4. In tropical forest, the termite mounds have different size and different shapes, and many are already not active mounds. This study only selected the relatively small size of termite mound (Table 1), thus it is not surprised that the authors gave the conclusion of weak correlation between CH_4 emission and mound size (3.1; Fig. 3).

5. This *in-situ* measurement could not be able to partition the contribution of mound soil (CO_2 source but CH_4 sink) from termite, thus the termite CH_4 emission could be underestimated but termite CO_2 emission could be overestimated. The results should be calibrated, because the structure and nutrients of the mound-soil are different from the normal soil (blank soil in this study).
6. Chamber volume (CV in L145; L159-163, L258-262) is a major parameter for calculation of flux rate (Equation 2). If the exact volume of the sample mound was not known, means CV was not known, based on the calculation using equation 2, the estimated both CH_4 and CO_2 fluxes (Table 2, 3; L218-222, L241-243) would be absolutely under- or over-estimated.
7. In my experience, this $R^2 > 0.95$ (L178 and other places) was non-believable. The chamber was relatively (or very) large (220 L), UGGA internal (pump) flow was only about 350 mL min^{-1}, the chamber air could not be mixed without installing one or two micro fans inside the chamber, because it takes about 630 min to replace the chamber air if only depending on the UGGA internal pump. Particularly, the chamber was about 1 m high, the emitted CH_4 and CO_2 was not be able to be mixed inside the chamber if only depending on both diffusion and UGGA internal pump. Moreover, based on the bag sampling (A1), CH_4 flux could be estimated. The authors are suggested to compare the result with that of mound chamber and sub sample.
8. Data was too limited; I strongly encourage the authors to show the data measured in the dry season (L348-350) and compare it with that of wet season showed in this manuscript.
9. Overall, using the limited data to scale up it to ecosystem (4.3) and global (4.4) levels would no doubt create large uncertainty. The authors are suggested to cancel or at least shorten these two issues.

Minor Comments:

L10 (L211, L284): Reads are easily be confused by the colony size and population, also the colony size of 50-120 thousands individuals and 54.6-116.6*10^3 termites per mound should be unified.

L120: Change “mount 15” to “mount #15”.

L120: Only one control (blank) made this result (also see above) weaker.

L130: The distance between the UGGA and chamber was 2 m.

L131: It is about 350 mL/min (from LGR).

L150-157 (2.5): Soil flux chamber had no mixing fan would have the same problem with the mound chamber (see above)

L177: Soil CO_2 emission of 0.47 μmol $collar^{-1}$ s^{-1} (1.87 μmol m^{-2} s^{-1}) was too small. The authors are suggested to compare it with other studies in tropical forests.

L187-189: Move to the Method, and L189-192 move to the caption of Figure 4.

L252-257: The statement of "air flow below the soil collar" does not make sense.

Equation 2: not completed; missed chamber pressure and chamber temperature.

L311: The statement of "Mound adjacent soil flux measurements showed no enhanced CH4 and CO2 fluxes in comparison to soils in the blank collar" does not consist with the results. For example, adjacent CO_2 flux (1.3) was almost three times of blank soil (0.47).

L337: 11 g is the maximum value; the variation range should be listed. Consequentially, the following value of 0.5-1.0 nmol m^{-2} s^{-1} was overestimated.

L415: Check the grammar.

A3: Shorten or discuss the scientific meaning of $\delta^{13}CO_2$ in this study.

Unify the concentration unit of ppm and μmol mol^{-1}.